

What is claimed is:

1           1.     A memory system comprising:  
2           a memory controller having an interface that includes a plurality of memory  
3 subsystem ports including a first memory subsystem port;  
4           a first memory subsystem including:  
5                 a buffer device having a first port and a second port, and  
6                 a plurality of memory devices coupled to the buffer device via the second  
7 port;  
8 and  
9           a plurality of point-to-point links, each point-to-point link having a connection to  
10 a respective memory subsystem port of the plurality of memory subsystem ports, the  
11 plurality of point-to-point links including a first point-to-point link connecting the first  
12 port to a first memory subsystem port to transfer data between the plurality of memory  
13 devices and the memory controller.

1           2.     The memory system of claim 1 further including a plurality of connectors  
2 each connected to a connection to a respective point-to-point link and a plurality of  
3 memory subsystems, each memory subsystem of the plurality of memory subsystems  
4 including:  
5                 a buffer device having a first port and a second port, wherein the first port is  
6 coupled to a respective connector of the plurality of connectors , and  
7                 a plurality of memory devices coupled to the buffer device via the second port.

1           3.       The memory system of claim 2 further including a plurality of substrates  
2 wherein each memory subsystem is disposed on a respective substrate of the plurality of  
3 substrates.

1           4.       The memory system of claim 1 wherein each of the plurality of point-to-  
2 point links, first memory subsystem, and memory controller include a common substrate.

1           5.       The memory system of claim 1 wherein the first memory subsystem  
2 further includes a plurality of channels and a plurality of memory device select lines  
3 connected between the plurality of memory devices and the second port.

1           6.       The memory system of claim 5 wherein each channel includes a plurality  
2 of terminated signal lines.

1           7.       The memory system of claim 1 wherein the buffer device of the first  
2 memory subsystem further includes at least one selected from the group consisting of a  
3 cache, a clock generator, and a clock alignment circuit.

1           8.       The memory system of claim 1 further including a plurality of sideband  
2 signals coupled between the plurality of memory devices of the first memory subsystem  
3 and the controller device.

1           9.       The memory system of claim 1 further including a plurality of sideband  
2 signals coupled between the plurality of buffer devices and the controller device.

1           10.      A memory system comprising:  
2 a controller device;

3           a first buffer device having a first interface and a second interface;  
4           a second buffer device having a first interface and a second interface;  
5           a first point-to-point link having a first connection to the controller device and a  
6 second connection to the first interface of the first buffer device;  
7           a first channel connected to the second interface of the first buffer device;  
8           a first plurality of memory devices electrically coupled to the first channel;  
9           a second point-to-point link having a first connection to the controller device and  
10 a second connection to the first interface of the second buffer;  
11           a second channel connected to the second interface of the second buffer device;  
12 and  
13           a second plurality of memory devices electrically coupled to the second channel.

1           11.    The memory system of claim 10, wherein the first buffer device, first  
2 channel and first plurality of memory devices are disposed on a first substrate, and the  
3 second buffer device, second channel, and second plurality of memory devices are  
4 disposed on a second substrate.

1           12.    The memory system of claim 11, further including a plurality of  
2 termination elements disposed on each of the first and second substrate, wherein a first  
3 plurality of termination elements are connected to the first channel, and a second plurality  
4 of termination elements are connected to the second channel.

1           13.    The memory system of claim 10, wherein the first buffer device further  
2 includes a third interface, the memory system further including:  
3           a third buffer device having a first interface and a second interface;

4           a third point-to-point link having a first connection to the third interface and a  
5   second connection to the first interface of the third buffer device;  
6           a third channel connected to the second interface of the third buffer device; and  
7           a third plurality of memory devices electrically coupled to the third channel.

1           14.    The memory system of claim 10 further including a third point-to-point  
2   link having a connection to the controller and a fourth point-to-point link having a  
3   connection to the controller.

1           15.    The memory system of claim 10 further including:  
2           a third channel connected to the second interface of the first buffer device;  
3           a third plurality of memory devices electrically coupled to the third channel;  
4           a fourth channel connected to the second interface of the second buffer device;  
5   and  
6           a fourth plurality of memory devices electrically coupled to the fourth channel.

1           16.    The memory system of claim 15 further including:  
2           a fifth and sixth channel connected to the second interface of the first buffer  
3   device;  
4           a fifth plurality of memory devices electrically coupled to the fifth channel; and  
5           a sixth plurality of memory devices electrically coupled to the sixth channel.

1           17.    The memory system of claim 10, further including at least one termination  
2   element disposed on the first buffer device and electrically connected to the first point-to-  
3   point link.

1           18.    The memory system of claim 10 wherein the first and second buffer  
2    devices each further include at least one selected from the group consisting of a cache, a  
3    clock generator and a clock alignment circuit.

1           19.    A memory system comprising:

2           a controller device;

3           a first and second plurality of buffer devices, each buffer device of the first and  
4    second plurality of buffer devices having an interface connected to a respective plurality  
5    of memory devices;

6           a first and second repeater device;

7           a first point-to-point link having a first connection to the controller device and a  
8    second connection to the first repeater device;

9           a second point-to-point link having a first connection to the controller device and  
10   a second connection to the second repeater device;

11          a first plurality of repeater links, each repeater link having a first connection to a  
12   respective buffer device of the first plurality of buffer devices, and a second connection  
13   to the first repeater device; and

14          a second plurality of repeater links, each repeater link having a first connection to  
15   a respective buffer device of the second plurality of buffer devices and a second  
16   connection to the second repeater device.

1           20.    The memory system of claim 19, wherein each buffer device of the first  
2    and second plurality of buffer devices and corresponding plurality of memory devices are  
3    each disposed on a one of a plurality of respective module substrates.

1           21.     The memory system of claim 19 further including a third point-to-point  
2 link having an end connected to the controller and a fourth point-to-point link having an  
3 end connected to the controller.

1           22.     The memory system of claim 19 wherein each buffer device of the first  
2 and second plurality of buffer devices each further include at least one selected from the  
3 group consisting of a cache, a clock generator, and a clock alignment circuit.

1           23.     A memory system comprising:  
2           a controller device having an interface;  
3           a first connector, second connector, and third connector;  
4           a first point-to point link having a first connection to the interface and a second  
5 connection to the first connector;  
6           a second point-to-point link having a first connection to the interface and a second  
7 connection to the second connector;  
8           a third point-to-point link having a first connection to the interface and a second  
9 connection to the third connector; and  
10          a first memory subsystem including:  
11               a buffer device having a having a first interface connected to the first  
12 connector, and a second interface; and  
13               a plurality of memory devices connected to the second interface.

1           24.     The memory system of claim 23 wherein the second and third connectors  
2 support coupling to respective second and third memory subsystems